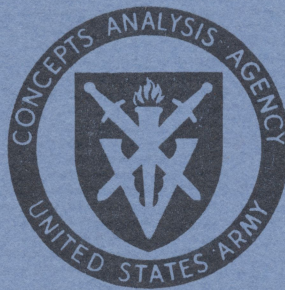


**NUCLEAR REQUIREMENTS METHODOLOGY II
(NUREM II)
TEST REPORT**

MARCH 1978



**PREPARED BY
WARGAMING DIRECTORATE**

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This report describes the procedures, results, and analyses of the test of the NUREM II processes. Six separate cases were examined to demonstrate the capability of the refinement made during the development of NUREM II. Results were examined and analyzed for reasonableness. The report concluded that the NUREM II refinements have increased the Army's nuclear analytic capability.		

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NUCLEAR REQUIREMENTS METHODOLOGY II

(NUREM II)

TEST REPORT

(QUALITY ASSURANCE)

31 March 1978

Prepared by

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SUMMARY

1. The Nuclear Requirements Methodology II (NUREM II) was tested to verify the following items:

a. That the expanded Subunit Status File (SUSF) exercises compatibly with all other parts of NUREM II.

b. That the new Fire Unit/Target Acquisition Routine (FUNTAR), including multiple-cycle target acquisition, complements all other parts of NUREM II.

c. That the Nuclear Fire Planning and Assessment Model II (NUFAM II) functions effectively with all other parts of NUREM II.

d. That the varied combat ineffectiveness breakpoints available by side for use in NUFAM II produce intended results.

e. That the preclusion-oriented nuclear targeting technique can be simulated using the preplanned target option of NUFAM II.

f. That the desired ground zero (DGZ) offset and target aggregation subroutines as used in NUFAM II provide reasonable results.

2. The following principal observations were made:

a. All components of the NUREM II processes appear to execute and interface properly.

b. The DGZ offset and target aggregation subroutines function, integrate properly in NUFAM II, and provide reasonable results.

c. As a result of expanded input data as well as routine and model refinements, future applications of NUREM II should consistently result in more reasonable simulations of tactical nuclear warfare than did NUREM.

3. Users of this document should familiarize themselves with the NUREM II Final Report.

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NUCLEAR REQUIREMENTS METHODOLOGY II
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(QUALITY ASSURANCE)

CHAPTER 1
INTRODUCTION

1-1. GENERAL. The Nuclear Requirements Methodology II (NUREM II) Study* was completed by the US Army Concepts Analysis Agency in January 1978. The study directive from Headquarters, Department of the Army, Deputy Chief of Staff for Operations and Plans (DAMO-SSN), dated 28 July 1977 outlined, in part, the purpose and scope of the NUREM II Study as:

" . . . To develop, test, and document an improved or refined NUREM. . . . The study will first identify necessary and desirable improvements in the NUREM that are compatible with the above objectives, and second incorporate these changes into NUFAM. . . ."

In that study, several significant refinements were identified and incorporated into the NUREM processes which were then redesignated NUREM II. These refinements were applicable to the Subunit Status File (SUSF) routine, Fire Unit/Target Acquisition Routine (FUNTAR), as well as the Nuclear Fire Planning and Assessment Model (NUFAM I). The revised NUFAM I was renamed NUFAM II. Data base and program modifications were accomplished to incorporate these changes. In the efforts leading to this report, which is an adjunct to the cited study, the NUREM II processes were exercised from potential target identification to damage assessment in order to demonstrate that (1) all data base and programing changes were correct and compatible throughout the processes, (2) all programs executed properly, and (3) the models and routines provided reasonable results.

1-2. OBJECTIVE AND TASKS. The objectives of this paper are to compare appropriate parts of the old NUREM to the same parts of NUREM II and confirm the capabilities of the new processes. These objectives are satisfied by the completion of the following tasks:

*Report CAA-SR-78-1, (S/RD) Nuclear Requirements Methodology II (NUREM II) (U), 31 January 1978.

- a. Demonstrate that the new SUSF routine exercises properly and the NUREM II processes operate with the increased numbers of subunit types and total subunits.
- b. Demonstrate that the FUNTAR can operate using variable durations for target acquisition and multiple cycles with probability of operational target acquisition (POTA) values. Compare the results of FUNTAR using POTA logic and data with the outcomes containing the percent of knowledge (POK) logic and data.
- c. Demonstrate that NUFAM II can operate reasonably with all incorporated changes. Compare the results of the NUREM processes using NUFAM I with the outputs obtained by using NUFAM II.
- d. Demonstrate that the NUREM II processes can operate reasonably with all incorporated changes to the SUSF, FUNTAR, and NUFAM II programs. Compare the results using NUREM with those from the NUREM II processes.
- e. Demonstrate that NUFAM II can operate with varied inputs for subunit combat ineffectiveness breakpoints. Compare the results of the NUREM II processes using different side (Red and Blue) breakpoint values.
- f. Demonstrate that NUFAM II can simulate detailed fire planning, warhead launch and detonation, and damage assessments in a manner to accommodate preclusion-oriented targeting techniques. Compare the results from NUFAM II when conducted with and without such preclusion-oriented targeting considerations.
- g. Examine a sample of primary and secondary targets to evaluate whether or not the target aggregation subroutine functions and considers properly all appropriate targets as well as troop minimum safe distance (MSD) and civilian collateral damage constraints.
- h. Examine a sample of targets and DGZ offsets to evaluate whether or not the DGZ offset subroutine functions and considers properly MSD and civilian collateral damage constraints.

1-3. NUREM II PROCESSES. Figure 1-1 shows the relationships among the portions of the overall NUREM II processes to be examined--potential target selection, fire planning, and assessment. First, the Subunit Status File (SUSF) routine produces a data file (often in tape format) which contains required location and contents information about all Red and Blue subunits (company-size or smaller elements) located on a hypothesized nuclear battlefield.

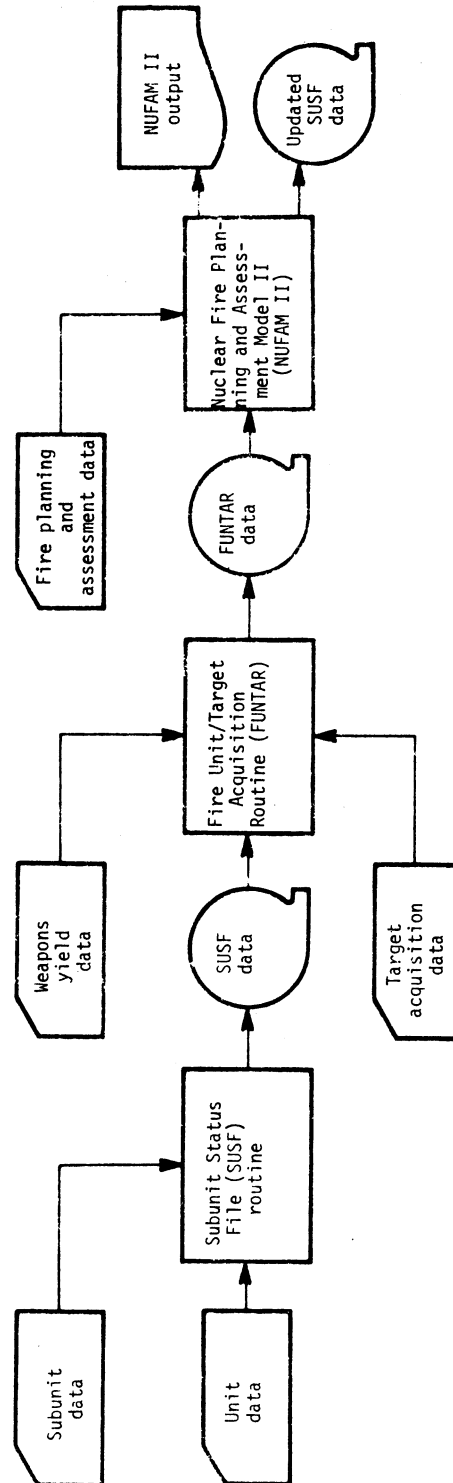


Figure 1-1. Flowchart of Potential Target Selection, Fire Planning, and Assessment Processes in NUFAM II

In the second stage, the SUSF, weapons yield, and target acquisition data are input to the Fire Unit/Target Acquisition Routine (FUNTAR). These inputs provide the FUNTAR logic with the information necessary to simulate the target acquisition process. The output data file from the FUNTAR has information to identify potential targets of opportunity for nuclear strikes as well as the identification of types of nuclear fire delivery systems. Third, both the FUNTAR and other fire planning and assessment data are input to NUFAM II. These inputs provide NUFAM II with the required information to select appropriate potential targets (detected subunits) as nuclear targets, perform detailed nuclear fire planning, simulate the launch and detonation of warheads, and perform casualty and damage assessments. These three activities are fundamental to both NUREM and NUREM II.

1-4. CHANGES TO THE NUREM PROCESS. Numerous changes, both major and minor, were made in these three steps of the NUREM processes. The changes are discussed in detail in the NUREM II Study Report. Major changes in the programs (as distinct from changes to input data) which significantly affect the output of the NUREM processes and are considered in this paper are:

a. The maximum allowable number of subunit types was increased from 50 to 100, and the maximum allowable total number of subunits in a single combat sample was expanded from 2,500 to 5,000. These changes resulted in a new and larger SUSF and correlated revisions to all three programs--SUSF, FUNTAR, and NUFAM II.

b. FUNTAR logic was modified to permit recycling of the target acquisition process in user-adjustable intervals of hours instead of days. This permitted the introduction of POTA data in lieu of POK values. These program modifications resulted in changes to the amounts and types of output data from both the new FUNTAR and NUFAM II.

c. A new subroutine was programmed for NUFAM II to cause searches of selected targets in turn and offsets of weapon DGZ from the primary target as necessary to meet civilian collateral damage or troop MSD constraints. In NUFAM I, shots would have been cancelled if these constraints were violated. In NUFAM II, shot cancellations occur only if offsetting the DGZ by the amount necessary to meet constraints will no longer achieve the prescribed military damage objectives. This refinement resulted in changes to the data value outputs of NUFAM II.

d. A target aggregation subroutine was written in conjunction with that for the DGZ offset. This logic aggregates potential targets in a specified area around a primary target whenever required military effects can be assured without reducing the expected damage to the primary target below a user-prescribed level. This change resulted in fire planning data outputs identifying the targets aggregated for a given warhead.

e. Model logic changes were made to allow the addition of a second breakpoint value for determining when a subunit is considered combat ineffective. Different values can now be input to represent different conditions for the Red and Blue sides, thereby reflecting differences in attack and defend missions. This change resulted in changes to the data value outputs of NUFAM II.

CHAPTER 2

METHODOLOGY

2-1. GENERAL. The purpose of this chapter is to outline the analytic approach used to examine the suitability of the program changes incorporated in NUREM II.

2-2. ANALYTIC APPROACH. As explained in paragraph 1-3, the parts of NUREM II to be analyzed pertain to three programs--SUSF, FUNTAR, and NUFAM II. The basic procedure will be to hold two of the three elements as constant as possible and demonstrate that NUREM II operates successfully with the third component. Then, the complete NUREM II will be exercised with the combined changes to all programs. In some cases, comparisons will be made using the results of the varied excursions with NUREM and NUREM II processes. Other procedures will involve examination of selected NUFAM II outcomes to insure that there are no apparent inconsistencies in model logic or results. In each test case the variables will be assigned to value sets. One value set will represent NUREM data or processes, and the other value set will apply to those for NUREM II. Throughout the excursions, the number of weapons, weapons characteristics and yields, weapons effects radii, delivery system and target location errors, protective postures for subunit personnel, and other related input data will be held constant. In regard to SUSF, the logic in the program will produce the same output data when provided identical input data. The FUNTAR output will also remain identical regarding the total numbers of detected subunits by zone. However, the specific subunits detected will vary. Three FUNTAR computer runs will be made to develop basic data (old SUSF and old FUNTAR, old SUSF and new FUNTAR, and new SUSF and new FUNTAR) to support the NUREM excursions chosen for investigation. The old FUNTAR logic and the new SUSF data are incompatible because the increase in size of the new SUSF exceeds the data storage capacity of the old FUNTAR; therefore, a computer run cannot be made with that combination. A random number generator seed is used in both NUFAM programs; therefore, the NUFAM versions will be executed with three seeds for each different set of input data. The analyses will be compartmented in six cases involving a total of 35 data comparisons. Table 2-1 describes the cases and computer runs required for this report.

Table 2-1. Computer Runs Used to Test NUREM II

Case	Run	Versions		Random number seeds		Break-point ^a values	Remarks ^b
		SUSF	FUNTAR	NUFAM I	NUFAM II		
I	1	Old	New		111	35/50	
	2	Old	New		215	35/50	
	3	Old	New		324	35/50	
	4	New	New		111	35/50	
	5	New	New		215	35/50	
II	6	New	New		314	35/50	graphic plot
	7	Old	Old	111		30/30	
	8	Old	Old	215		30/30	
	9	Old	Old	324		30/30	
	10	Old	New	111		30/30	
	11	Old	New	215		30/30	
	12	Old	New	324		30/30	
III	7	Old	Old	111		30/30	
	8	Old	Old	215		30/30	
	9	Old	Old	324		30/30	
	13	Old	Old		111	35/50	
	14	Old	Old		215	35/50	
	15	Old	Old		324	35/50	
IV	7	Old	Old	111		30/30	
	8	Old	Old	215		30/30	
	9	Old	Old	324		30/30	
	1	Old	New		111	35/50	
	2	Old	New		215	35/50	
	3	Old	New		325	35/50	
V	16	New	New		111	10/10	
	17	New	New		111	20/20	
	18	New	New		111	30/30	
	19	New	New		111	40/40	
	20	New	New		111	50/50	
	21	New	New		111	60/60	
	22	New	New		111	70/70	
	23	New	New		111	80/80	
VI	24	New	New		111	90/90	
	4	New	New		111	35/50	
	25	New	New		111	50/35	with preplanned targets

^aThe percentage number in the first position applies to Red subunits; the second position is for Blue subunits. For example in Run 1: if 35 percent of the personnel in a given Red subunit become immediate permanent and immediate transient casualties combined, that subunit is considered combat ineffective.

^bAll computer runs were made without preplanned fires unless otherwise indicated.

2-3. TASK ACCOMPLISHMENTS. Each task for this report was achieved as follows:

a. The SUSF routine was demonstrated using both the old (small) and the new (large) SUSF (Case I). A flowchart of the Case I procedures is shown in Figure 2-1. For this case the principal variations in the NUREM processes were in the SUSF data; therefore, differences in the NUFAM II outputs can be attributed reasonably to differences in the particular old and new SUSF and the effects of the random number generator seed.

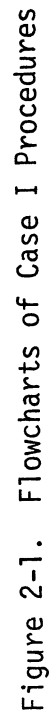
b. The FUNTAR was exercised using POK in the old FUNTAR and POTA in the new FUNTAR (Case II), as shown by the flowchart in Figure 2-2. The variables in the FUNTAR were in the target acquisition subprograms and the different POK or POTA values. In this case, differences in the NUFAM I outputs can be attributed to variations in (1) the old and new FUNTAR logic, (2) target acquisition input (POK and POTA values), and (3) those caused by the random number generator seeds.

c. The overall process was performed using both NUFAM I and NUFAM II (Case III) as indicated in Figure 2-3. Because the only variables in the NUREM processes in Case III were introduced by the use of different NUFAM programs, variations in the NUFAM outputs can be attributed to those caused by different NUFAM logics and the random number generator seeds.

d. The overall process was demonstrated further by using the old SUSF with old and new versions of both the FUNTAR and NUFAM programs (Case IV). A flowchart of the Case IV procedures is shown in Figure 2-4. The varied SUSF, FUNTAR, and NUFAM elements were applied in two excursions, and differences in the NUFAM outputs can be attributed to the combined effects of the old and new FUNTAR and NUFAM programs as well as the random number generator seeds.

e. The NUREM II was applied using nine different breakpoints for subunit combat ineffectiveness (Case V) as illustrated by the flowchart in Figure 2-5. Because the dominant variables in the NUREM II processes were the pairings of breakpoint values by side, differences in the NUFAM II output can be attributed to those values and the random number generator seeds.

f. The overall NUREM II was executed again, but with preplanned targets (Case VI) as indicated in Figure 2-6. Results were examined to determine (1) whether or not the preplanned target routines function reasonably, and (2) the extent that a limited use of preplanned targets impacts on NUFAM II operations.



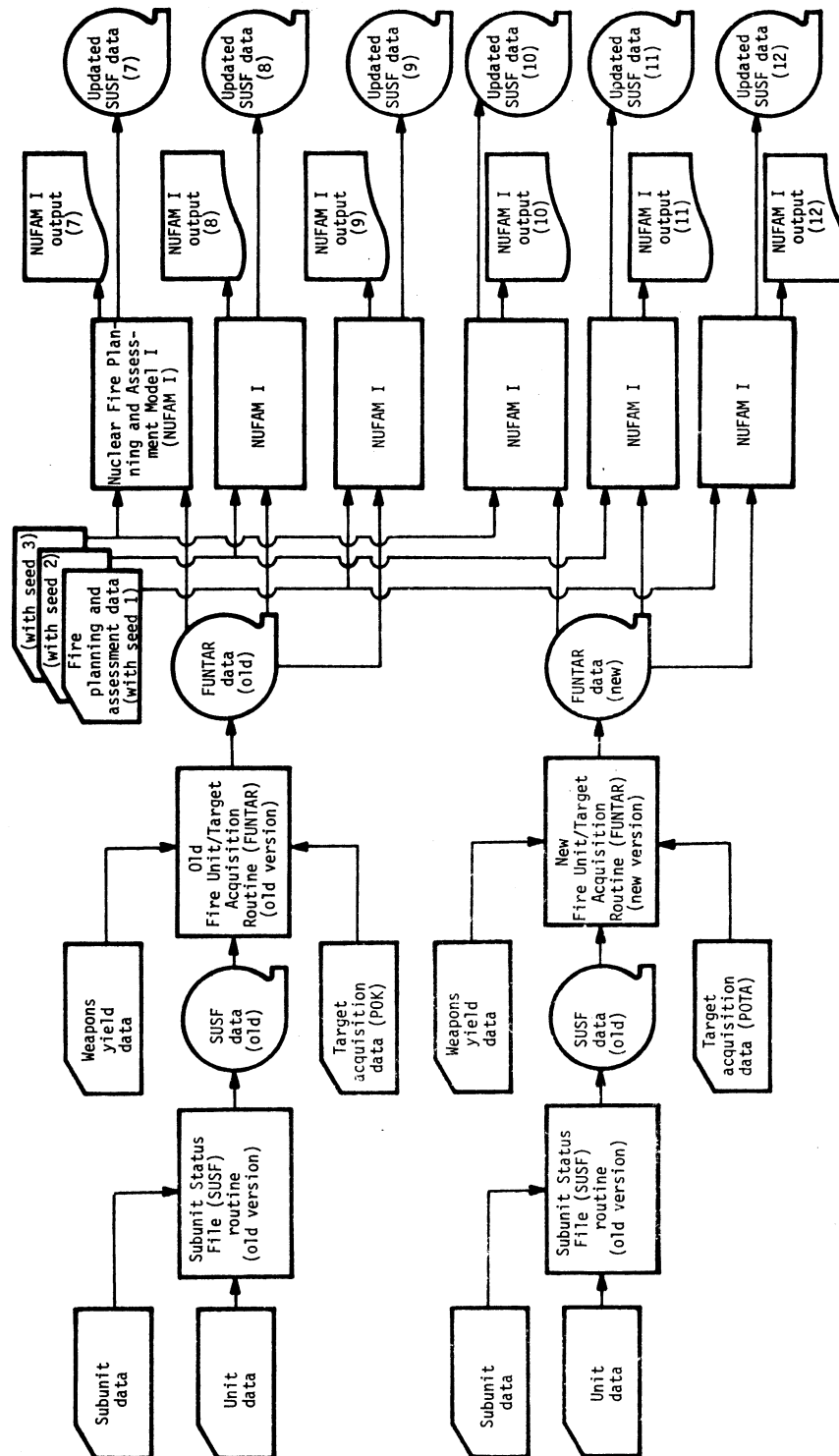


Figure 2-2. Flowchart of Case II Procedures

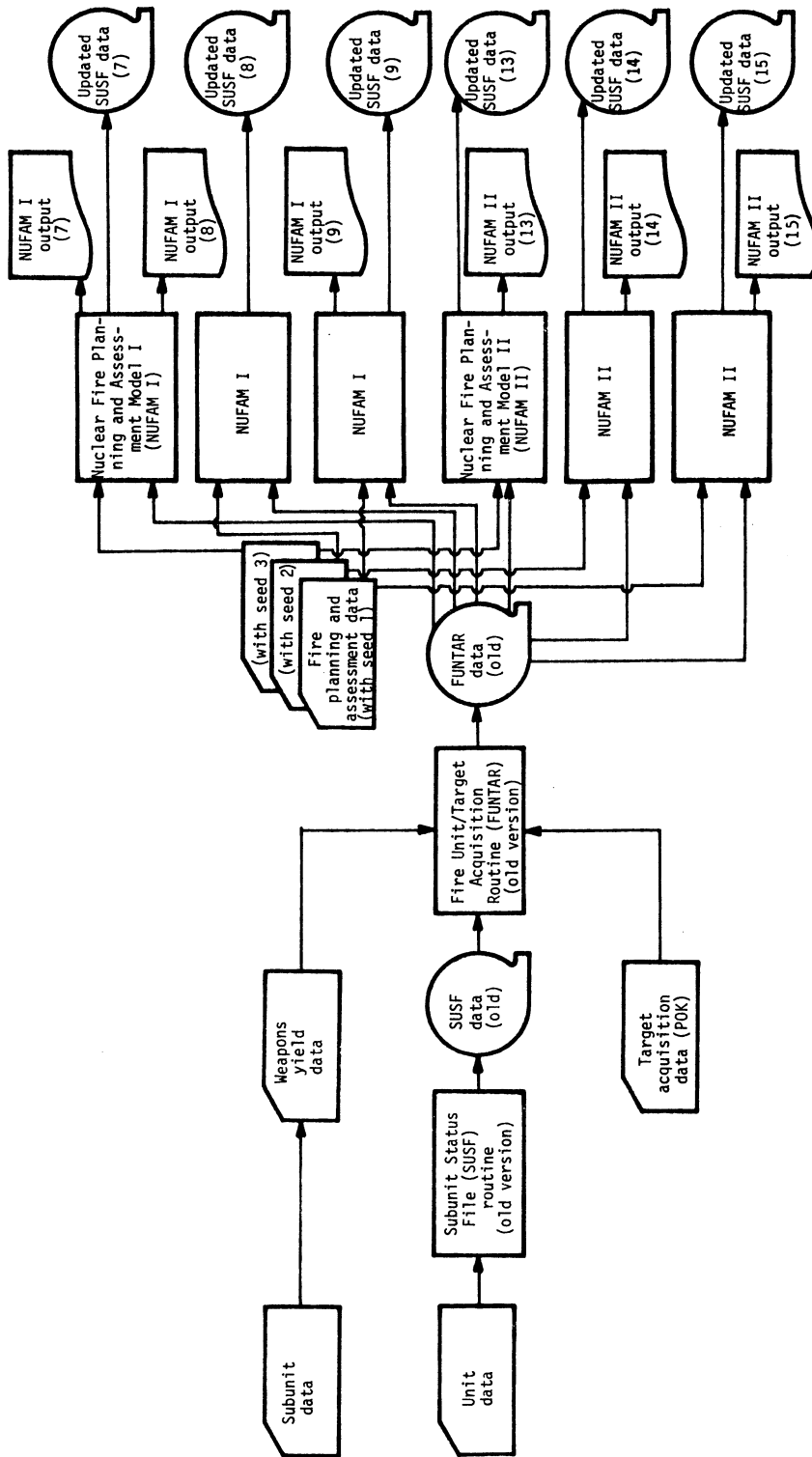


Figure 2-3. Flowchart of Case III Procedures

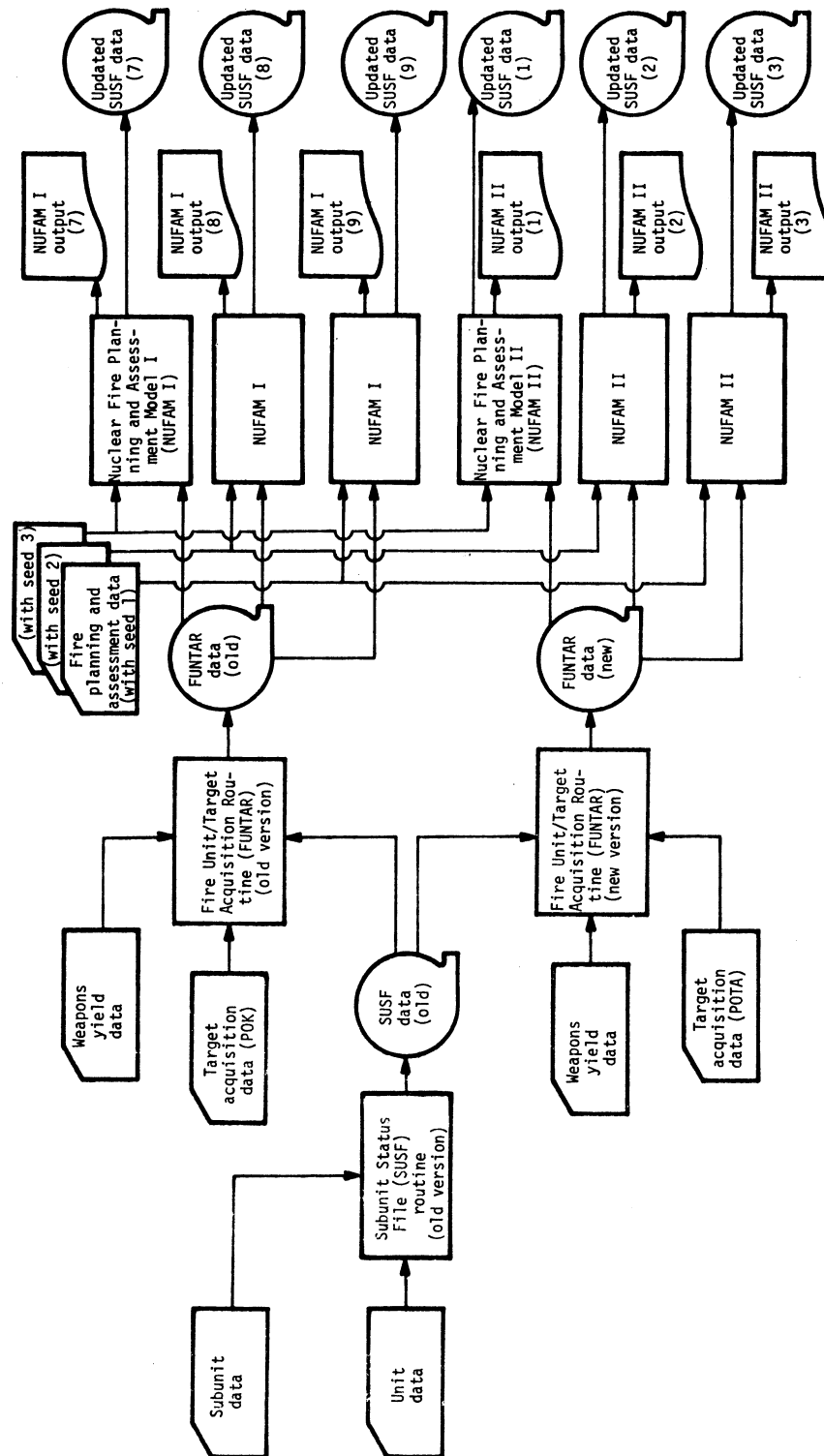


Figure 2-4. Flowchart of Case IV Procedures

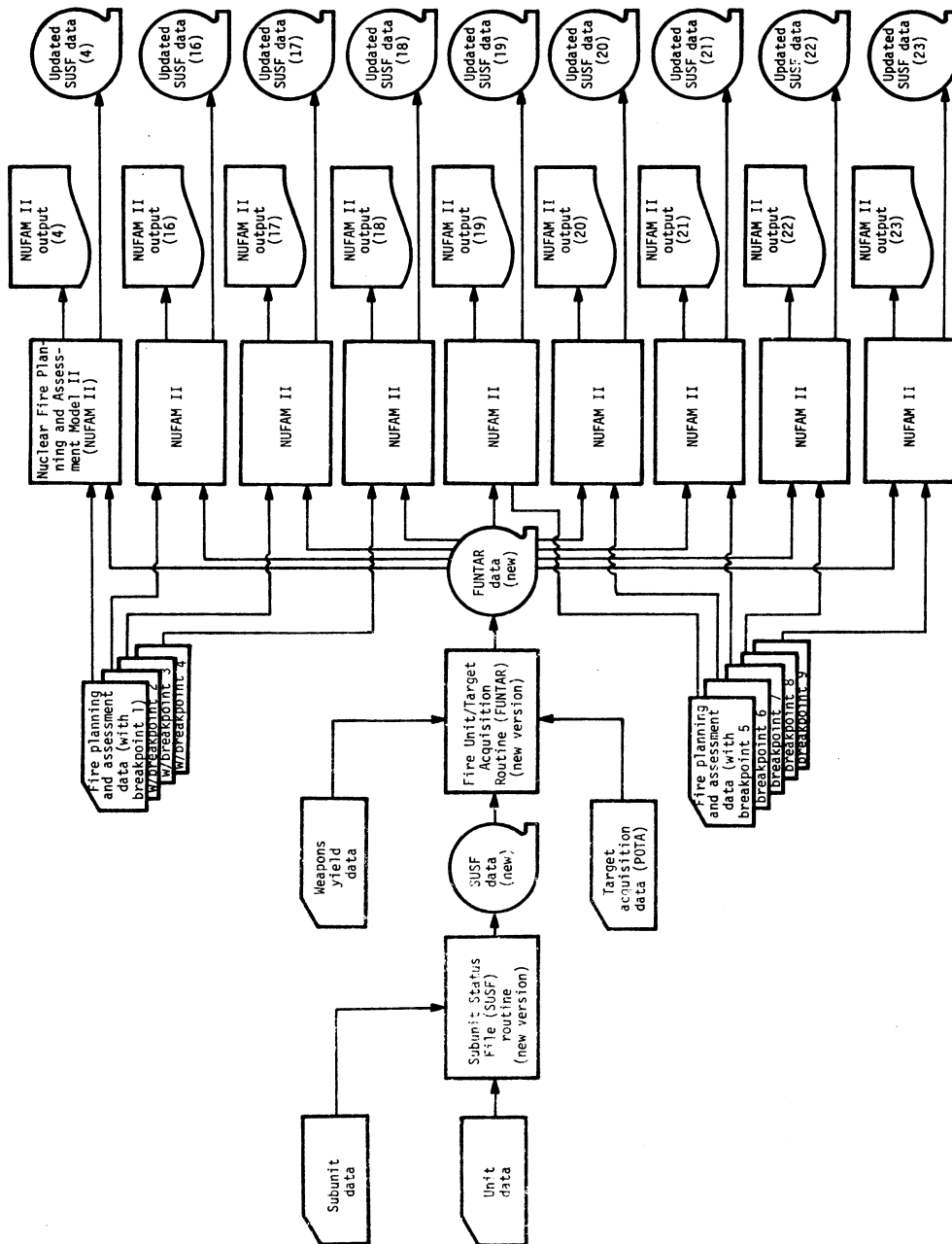


Figure 2-5. Flowchart of Case V Procedures

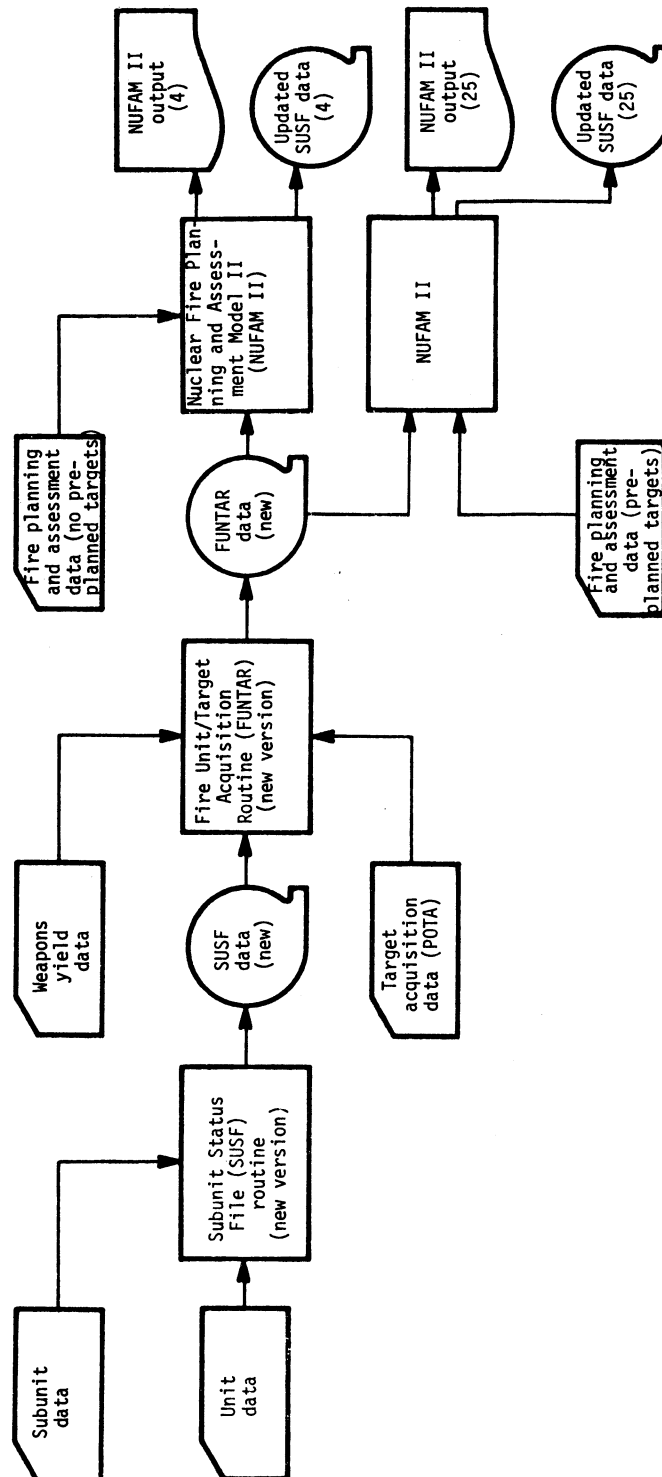


Figure 2-6. Flowchart of Case VI Procedures

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g. The NUFAM II path for Case I included a graphics display option. This computer run produced a plot of the NUFAM II results with respect to actual ground zero points, selected radii of effects, and subunits on the battlefield. Observation of a sampling of offset DGZ and aggregated target data permitted a general assessment of the validity of these routines.

CHAPTER 3

TEST RESULTS

3-1. CASE I. In Case I (Figure 2-1), an example from the old SUSF routine, using a data set of a maximum of 50 subunit types and 2,500 total units (Set A), was compared to an example of the new SUSF routine, using a data set of a maximum of 100 subunit types and 5,000 total subunits (Set B). The Set B file as shown in Table 3-1 contained 2.71 times as many subunits as did that from Set A (3,326 versus 1,228). Also, Sets A and B had 50 and 93 types of subunits, respectively. The SUSF data resulting from both sets were input to the new FUNTAR logic (POTA) while weapons yield and target acquisition input data were held constant. The FUNTAR file based on Set B contained 2.80 times as many potential targets (detected subunits) as did the file based on Set A (912 versus 326). The number of detected subunits was in approximately the same ratio as the number of subunits present in the sample (2.80 to 2.71). This is consistent with POTA concepts when the distribution of subunits by targets zones is considered. Both FUNTAR files were input to NUFAM II, and the fire planning and assessment data base file was held constant. The NUFAM II was executed for each FUNTAR file and three random number generator seeds to produce six NUFAM II outcomes. Runs 4 through 6 (Table 3-1) show that the new SUSF routine successfully extends beyond the subunit limitations of the old program and is compatible with the FUNTAR process. The new program limitations of 100 subunit types and 5,000 total subunits have not been confirmed by testing. The effort to develop a sample containing at least 101 subunit types and 5,001 total subunits to illustrate new limits is not warranted, because knowledge of computer programming leads to the intuitive conclusion that such limitations cannot be exceeded.

Table 3-1. Case I Comparisons (reflecting SUSF changes)

Set	Run	SUSF		FUNTAR potential targets
		Subunit types	Total subunits	
A	1	50	1,228	326
	2	50	1,228	326
	3	50	1,228	326
B	4	93	3,326	912
	5	93	3,326	912
	6	93	3,326	912

3-2. CASE II. In Case II (Figure 2-2), the old SUSF file was used: (a) with the old FUNTAR and an input file containing POK values (Set C), and (b) with the new FUNTAR using an input value containing POTA data (Set D). The weapons yield data and the target acquisition period were not changed. The FUNTAR file based on Set C contained approximately 1-1/2 times as many detected subunits as did the FUNTAR file for Set D (626 vs 415). However, POK results are based on a 24-hour acquisition period while POTA requires a user-varied duration of hours for the acquisition interval. The results of the POK condition were linearly adjusted to consider only those subunits acquired over the same time span as the POTA condition. In the specific case tested (Table 3-2), the FUNTAR file generated with POTA data contained approximately twice as many detected subunits as when using POK for the same time span (326 vs 151). Then, data for Sets C&D were input to NUFAM I while the fire planning and assessment data base file was unchanged. NUFAM I was executed for each condition and with three random number generator seeds to provide six outcomes. Runs 10 through 12 (Table 3-2) show that the new FUNTAR logic operates with POTA values and is compatible with NUFAM I processes. Runs 7-12 demonstrate that for the given data, NUFAM I results based on POTA values (Set D) generally reflect (a) more potential and selected targets, (b) more simulated rounds fired, (c) more military casualties, (d) more subunits made combat ineffective, and (e) more civilians placed at risk than do NUFAM I outcomes based on POK data (Set C). A major reason for this is that the application of POK data assumed a uniform distribution of detections over the 24-hour time period. In actuality, more of the detections in the 24-hour period would occur in the early portion of the period as portrayed with cyclic application of POTA. Another reason for increased detections using POTA is the fact that POTA considers newer and more sophisticated target acquisition means than does POK. Documentation of POTA values in CAA's Target Acquisition Study is more extensive than documentation of POK values. For the purposes of the NUREM II test, these values were used as inputs only. No means were available to test the validity of the individual values used. Work is in progress to better define target acquisition input values.

Table 3-2. Case II Comparisons (reflecting FUNTAR changes)

Case	Run	SUSF subunits	FUNTAR potential targets	NUFAM selected targets	Rounds fired ^a			Rounds cancelled			Military casualties			Subunits made combat ineffective			Civilians placed at risk by forces ^b		
					B	R	T	B	R	T	B	R	T	B	R	T	B	R	T
C	7	1,228	151 ^c	83	23	16	39	16	5	21	1,601	1,694	3,295	15	27	42	3,969	2,984	6,953
	8	1,228	151	83	14	10	24	21	2	23	1,528	980	2,508	17	19	36	1,197	1,640	2,837
	9	1,228	151	83	16	12	28	17	5	22	1,988	1,171	3,159	24	19	43	1,397	15,603	17,000
D	10	1,228	326	231	40	49	89	48	22	70	6,303	3,894	10,197	76	59	135	9,114	54,480	63,600
	11	1,228	326	231	47	50	97	43	21	64	5,764	5,311	11,075	82	78	160	13,701	71,136	84,837
	12	1,228	326	231	47	50	97	46	23	69	5,441	5,104	10,545	75	79	154	9,586	30,926	40,512

^aB--Blue, R--Red, T--totals^bExposure to 150 rad or more with five percent requiring hospitalization when assumed to be in basements of one-story masonry buildings in an urban environment.^cAdjusted results to consider subunits detected over the same time span as for Set D.

3-3. CASE III. In Case III (Figure 2-3), outcomes from NUFAM I, which used the old fire planning methodology and supporting fire planning and assessment data file (Set E), were compared to those from NUFAM II with the new fire planning methodology and supporting fire planning and assessment data file (Set F). The old FUNTAR file (Set C conditions) was entered in both NUFAM I and NUFAM II to complete the input data requirements. Each version of NUFAM was exercised three times with different random number generator seeds. Three outcomes were produced for each model condition. Runs 13 through 15 (Table 3-3) indicate that NUFAM II operates reasonably when target acquisition is performed as for Set C. Runs 7 through 9 for NUFAM I and 13 through 15 for NUFAM II suggest that NUFAM II logic generally results in more military casualties and subunits made combat ineffective than does that of NUFAM I. Although the numbers of rounds simulated as fired for Set F were higher than those for Set E in two of three runs, there is no apparent pattern in the number of rounds that NUFAM II logic would schedule for firing compared to that for NUFAM I. Influencing this condition, the DGZ offset subroutine will move the ground zero location to prevent shot cancellation as a result of MSD or civilian collateral damage constraints. This action tends to increase the number of rounds that NUFAM II logic will schedule for firing. On the other hand, the target aggregation logic will attempt to place the ground zero so that one round will achieve prescribed military damage levels on two or more detected subunits. Such aggregation tends to reduce the number of rounds scheduled for firing in NUFAM II. The net result of the combined actions is, however, dependent on the situation and distribution of subunits.

3-4. CASE IV. In Case IV (Figure 2-4), results from an overall NUREM process (Set G) as defined for this test were compared to those from comparable NUREM II conditions (Set H). However, only the old SUSF file was used to develop old and new versions of FUNTAR data for input to the companion programs for NUFAM, each of which were exercised three times with different random number generator seeds. Thus, three outcomes were available for each model version. The modified NUREM II processes under Set H conditions resulted in the detection of approximately twice as many subunits as did the NUREM processes under Set G circumstances (326 versus 151). Data exhibiting these results are extracted in Table 3-4. Also under Set H, approximately three times as many targets were selected as under Set G conditions (231 versus 83). The NUREM II processes, when compared to those for NUREM, resulted in greater numbers of rounds fired as well as numbers of military casualties and civilians placed at risk.

Table 3-3. Case III Comparisons (reflecting NUFAM changes)

Case	Run	SUSF subunits	FUNTAR potential targets	NUFAM selected targets	Rounds fired ^a			Rounds cancelled			Military casualties			Subunits made combat ineffective			Civilians placed at risk by forces ^b		
					B	R	T	B	R	T	B	R	T	B	R	T	B	R	T
E	7	1,228	151 ^c	83	23	16	39	16	5	21	1,601	1,694	3,295	15	27	42	3,969	2,984	6,953
	8	1,228	151	83	14	10	24	21	2	23	1,528	980	2,508	17	19	36	1,167	1,640	2,807
	9	1,228	151	83	16	12	28	17	5	22	1,988	1,171	3,159	24	19	43	1,397	15,603	17,000
F	13	1,228	151	83	23	15	38	14	2	16	2,332	2,043	4,375	23	32	55	7,049	11,477	18,526
	14	1,228	151	83	20	8	28	23	11	34	1,151	1,792	2,943	13	27	40	5,897	1,435	7,332
	15	1,228	151	83	20	6	26	18	6	24	975	1,644	2,619	11	26	37	7,083	358	7,441

^aB--Blue, R--Red, T--totals^bExposure to 150 rad or more with five percent requiring hospitalization when assumed to be in basements of one-story masonry buildings in an urban environment.^cAdjusted results to consider subunits detected over the same time span as for Set D.

Table 3-4. Case IV Comparisons (reflecting overall NUREM changes)

Case	Run	SUSF subunits	FUNTAR potential targets	NUFAM selected targets	Rounds fired ^a			Rounds cancelled			Military casualties			Subunits made combat ineffective			Civilians placed at risk by forces ^b		
					B	R	T	B	R	T	B	R	T	B	R	T	B	R	T
G	7	1,228	151 ^c	83	23	16	39	16	5	21	1,601	1,694	3,295	15	27	42	3,969	2,984	6,953
	8	1,228	151	83	14	10	24	21	2	23	1,528	980	2,508	17	19	36	1,167	1,640	2,807
	9	1,228	151	83	16	12	28	17	5	22	1,988	1,171	3,159	24	19	43	1,397	15,403	17,000
H	1	1,228	326	231	55	42	97	35	35	70	5,381	5,920	11,301	72	87	159	18,990	27,878	46,868
	2	1,228	326	231	62	47	109	39	19	58	5,422	6,795	12,217	64	104	168	27,644	22,125	49,769
	3	1,228	326	231	46	43	89	42	26	68	6,601	4,893	11,494	72	73	145	23,460	28,313	51,773

^aB--Blue, R--Red, T--totals^bExposure to 150 rad or more with five percent requiring hospitalization when assumed to be in basements of one-story masonry buildings in an urban environment.^cAdjusted results to consider subunits detected over the same time span as for Set D.

Runs 1 through 3 denote the capability of the NUREM II processes to operate compatibly with the old SUSF and the collective changes to the FUNTAR and NUFAM II programs. Runs 1 through 3 (for NUREM II) and 7 through 9 (for NUREM) show that NUREM II processes, with the input data used in this analysis, generally will generate more potential targets and then select more targets, fire more simulated rounds, and estimate more military casualties than will those for NUREM. These excursions also supported the fact that varied random number seeds result in different but similar NUFAM II results when other data are not changed, and identical seeds produce the same outcomes.

3-5. CASE V. In Case V (Figure 2-5), the new SUSF routine and the new FUNTAR were used together--the results being input to NUFAM II logic with an appropriate fire planning and assessment data base file. The latter file was varied only with respect to the combat ineffectiveness breakpoint values. This case exhibits excursions with all of the major NUREM II programs under investigation. Runs 16 through 24 (Table 3-5) indicate that NUFAM II logic accepts varied breakpoint values by side. Analysis of one computer run revealed that for the given set of input data large numbers of military casualties were assessed against those primary targets actually receiving simulated fires. In fact, fifty percent of all targets fired on were assessed 90 percent or more casualties. Therefore, such targets would become combat ineffective for any given breakpoint value of from 0 to 90. As shown in Table 3-5, the NUFAM II results from using the chosen input data were somewhat insensitive to changes in breakpoint values. For Blue, the numbers of combat ineffective subunits decreased from 9 to 6 for the breakpoint values of from 10 to 80. Similarly, for Red, the numbers of combat ineffective subunits ranged from 35 to 26 for breakpoint values of from 20 to 90. The relatively small sizes of the assessed subunits and the large effects radii for the delivered warheads probably account for this condition. However, the impact on Red forces will be proportionately less drastic because more Red than Blue subunits are in the vicinity of the primary targets in this sample. The Case V excursions also confirmed that the new SUSF, FUNTAR, and NUFAM II logic and data operate successfully within the framework of NUREM II.

Table 3-5. Case V Comparisons (reflecting varied combat ineffectiveness breakpoints)^a

Run	Blue		Red	
	Breakpoint value	Subunits made combat ineffective	Breakpoint value	Subunits made combat ineffective
16	10	9	10	45
17	20	9	20	35
18	30	8	30	35
19	40	8	40	34
20	50	8	50	32
21	60	8	60	30
22	70	7	70	27
23	80	6	80	26
24	90	2	90	26
1	50	8	35	35

^aA subunit is deemed combat ineffective when more than the specified percentage (breakpoint) of personnel available to that subunit are immediate permanent and immediate transient casualties combined.

3-6. CASE VI. In Case VI (Figure 2-7), the new SUSF routine and the new FUNTAR were input to the NUFAM II program along with two versions of the fire planning and assessment data file. In one example (Run 25), preplanned targets were introduced to the simulation. The DGZ for one target was deliberately set for the center of a population center (Coburg) to confirm whether or not the model logic for handling preplanned fires could override civilian collateral damage constraints, if required. Additional planned DGZ were also input for the other locations. The model properly detailed the fire planning for all of these targets, and the actual ground zeros (AGZ) were close enough to the DGZ such

that the location differences could be reasonably accounted for by delivery system errors. The NUFAM II logic properly assessed casualties against military subunits within the effects radii for the preplanned bursts. The weapon planned for the center of Coburg resulted in placing over 17,000 civilians at risk in a population of approximately 38,000. Patently this shot would have been cancelled if it were fire planned as a target of opportunity. In another excursion the excessive total numbers of civilians placed at risk by each side exceeded predefined limits, and the computer run terminated appropriately at midterm. Results from Run 25 (Table 3-6) indicate that preplanned targets can be used in NUFAM II in conjunction with automated fire planning against discrete targets. This preplanned mode of operations can accommodate the preclusion-oriented targeting technique in addition to the normal mode of operation.

3-7. TARGET AGGREGATION AND DGZ OFFSET. A sufficient sample of NUFAM II results was analyzed to determine that the target aggregation and DGZ offset subroutines function reasonably. During the fire planning phase in all the NUFAM II excursions, a number of potential targets of opportunity and predetermined priorities were routinely aggregated--usually two subunits. The largest number of aggregated targets was four. During the simulated warhead launch and the damage assessment phases, aggregated subunits were fired on as a group and then each was assessed by the same methods as for primary targets. Also, a number of DGZ were routinely offset to meet troop MSD or civilian collateral damage criteria. The AGZ offset distances from actual target locations varied from 0 to 1,100 meters. Graphic plots of population centers, perceived target locations, and AGZ were compared and analyzed. These analyses showed that AGZ (and presumably DGZ) locations generated by both the offset and aggregation subroutines were in reasonable directions and at proper distances. The effort required to prove by numerical computation that the DGZ displacements were accurate was considered unwarranted.

Table 3-6. Case VI Comparisons (reflecting preplanned fires)

Condition	Run	SUSF total subunits	FUNTAR potential targets	NUFAM I selected targets	Rounds fired ^a			Rounds cancelled			Military casualties			Subunits made combat			Civilians placed at risk by forces ^b ineffective		
					B	R	T	B	R	T	B	R	T	B	R	T	B	R	T
With preplanned fires	25	3,326	912	255	21	9	30	87	4	91	710	2,349	3,059	8	41	49	26,292	258	26,550
Without preplanned fires	4	3,326	912	255	18	9	27	84	4	88	710	2,025	2,735	8	35	43	3,319	258	3,577

^aB--Blue, R--Red, T--totals^bExposure to 150 rad or more with five percent requiring hospitalization when assumed to be in basements of one-story masonry buildings in an urban environment.^cAdjusted results to consider subunits detected over the same time span as for Set D.

CHAPTER 4

OBSERVATIONS

4-1. GENERAL. The following observations have been segregated with respect to the overall methodology and the major programs which govern the outcomes of the varied processes.

4-2. NUREM II. a. The NUREM II processes operate with the collective changes to the SUSF, FUNTAR and NUFAM II programs.

b. It is reasonable to expect in a given situation that comparable output data elements for NUREM II will be generally larger in value than those for NUREM because more subunits are presented to the FUNTAR for possible detection.

c. Varied random number generator seeds result in different but comparable NUFAM II results where other data are not changed, and identical seeds produce the same outcomes.

4-3. SUSF. a. The new SUSF routine is compatible with all other NUREM II processes.

b. The new SUSF routine successfully exceeds the former limitation of 50 subunit types and 2,500 total subunits.

4-4. FUNTAR. a. The new FUNTAR logic operates using POTA values instead of POK data.

b. Current POTA values used with the target acquisition subroutine and a two-cycle acquisition interval caused approximately twice as many subunits to be detected as did POK values without recycling.

c. The new FUNTAR routine using POTA values is compatible with the other NUREM II processes.

4-5. NUFAM II. a. The NUFAM II operates with the newly programmed subroutines and supporting data base.

b. It is reasonable not to expect discernable patterns between the NUFAM I and NUFAM II outcomes as pertain to the number of rounds fired.

c. The use of varied breakpoint values by side for determining combat ineffectiveness of subunits can be accommodated in NUFAM II.

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d. For the given set of input data, NUFAM II was relatively insensitive to changes in subunit breakpoint values. This insensitivity cannot be assumed for other fire planning conditions; input data must be coordinated for each combat sample application.

e. The target aggregation and DGZ offset features of NUFAM II operate properly.

f. The simulation of preplanned targets operates properly in the fire planning and assessment phases of NUFAM II. This mode of operation will be beneficial in simulating preclusion-oriented targeting techniques.

APPENDIX A
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